Report of the Kew Committee for the Year ending October 31, 1888.

The operations of The Kew Observatory, in the Old Deer Park, Richmond, Surrey, are controlled by the Kew Committee, which is constituted as follows:

Mr. Warren de la Rue, *Chairman.*

Captain W. de W. Abney, C.B., R.E.	Admiral Sir G. H. Richards, K.C.B.
Prof. W. G. Adams.	The Earl of Rosse.
Staff-Commander E. W. Creak, R.N.	Mr. R. H. Scott.
Prof. G. C. Foster.	Lieutenant-General R. Strachey, C.S.I.
Mr. F. Galton.	General J. T. Walker, C.B.

The work at the Observatory may be considered under the following heads:—

1st. Magnetic observations.
2nd. Meteorological observations.
3rd. Solar observations.
4th. Experimental, in connexion with any of the above departments.
5th. Verification of instruments.
6th. Rating of Watches and Marine Chronometers.
7th. Miscellaneous.

I. Magnetic Observations.

There have been no changes introduced in the magnetographs during the year, but the building operations referred to later on have involved the introduction of several pieces of iron, in the shape of girders, standards, rails, &c., both temporarily and permanently, into the field of action of the magnets, and will therefore somewhat complicate the corrections necessary to render the observations comparable with those made prior to the alterations. Fortunately the building in which the absolute observations are made is sufficiently remote (about 100 yards) from the main building to be quite unaffected by these sources of magnetic disturbance.

The photographed magnetic curves representing Declination,

Horizontal Force, and Vertical Force variations have been secured uninterruptedly throughout the past year, and in accordance with the usual practice the scale values of all the instruments were determined in January last.

The following values of the ordinates of the different photographic curves were then found :—

Declination : 1 inch=0° 22′·04. 1 cm.=0° 8′·7.

Bifilar, January 12, 1888, for 1 inch δH = 0·0279 foot grain unit.
„ 1 cm. „ = 0·00051 C.G.S. unit.
Balance, January 16, 1888 „ 1 inch δV= 0·0282 foot grain unit.
„ 1 cm. „ = 0·00051 C.G.S. unit.

The distance between the dots of light upon the vertical force cylinder having become too small for satisfactory registration, the instrument was re-adjusted for balance. This was done on January 19th, after which the scale value was re-determined with the following result :—

Balance, January 21, 1888, for 1 inch δV = 0·0278 foot grain unit.
„ 1 cm. „ = 0·00050 C.G.S. unit.

In February experiments were undertaken to verify the temperature corrections of the force magnetographs as well as of the barograph by artificially heating the room in which these instruments are at work. A rough temporary fireplace was built of bricks and slates, in which a charcoal fire was lighted for several hours. This was subsequently extinguished and the windows were thrown wide open in order to admit the cold night air for a corresponding period. By this means changes of temperature of about 20° F. were several times made. The resultant effect in the case of the bifilar was very small indeed, but with respect to the balance magnetometer, it was considerable, as expected.

In order to ascertain whether the experiments had affected the permanent magnetism of the needles, or had otherwise influenced the instruments, scale value determinations were made on March 20th, and as will be seen by the following note, no appreciable effect had been produced in the sensibility of the V.F. magnetometer by the operation.

Balance, March 20, 1888, for 1 inch δV = 0·0277 foot grain unit.
„ 1 cm. „ = 0·00050 C.G.S. „

Small unimportant repairs have been made to the recording apparatus when necessary.

Although the magnets generally have been more active than in the preceding year, no very large movements have been registered.

The principal disturbances were recorded on the following dates :

November 21, 1887, January 23, April 11–12, May 21, August 3, and October 19–22, 1888.

The monthly observations with the absolute instruments have been made as usual, and the results are given in the tables forming Appendix I of this Report.

The following is a summary of the number of magnetic observations made during the year:—

Determinations of	Horizontal Intensity.....	36
,,	Inclination.....	124
,,	Absolute Declination.....	39

The magnetograph curves made use of in the preparation of the tables of diurnal range of Declination (see Appendix I, Table III) have been reproduced from the original photographs by means of an eidograph kindly lent by Captain Wharton, F.R.S., the Hydrographer.

A complete set of self-recording magnetographs by Casella, London, similar in construction to the instruments recently supplied to the Royal Cornwall Polytechnic Society, have been examined at the Observatory.

Information on matters relating to terrestrial magnetism and various data have been supplied to Professors Rücker, Piazzi Smyth, Dr. Rijckevorsel, and Messrs. Wilkinson and Harrison.

Magnetic Reductions.—At the request of the Rev. S. J. Perry, copies of the Kew Horizontal Force curves for certain selected days during the years 1883 to 1886 are now being made.

II. Meteorological Observations.

The several self-recording instruments for the continuous registration respectively of Atmospheric Pressure, Temperature, and Humidity, Wind (direction and velocity), Bright Sunshine, and Rain, have been maintained in regular operation throughout the year.

The standard eye observations for the control of the automatic records have been duly registered, together with the daily observations in connexion with the U.S. Signal Service synchronous system. A summary of these observations is given in Appendix II.

The tabulation of the meteorological traces has been regularly carried on, and copies of these, as well as of the eye observations, with notes of weather, cloud, and sunshine have been transmitted to the Meteorological Office.

Owing to trouble caused by bursting of the water-reservoir for the thermograph wet-bulbs during frosty weather, and the risk of their imperfect action owing to leakage of water, a double tank has been made, so that in the event of the inner vessel bursting, the outer one will prevent any loss of water.

The number of instruments under observation has been increased by the addition of a snow gauge on Professor Nipher's principle for the purpose of measuring falls of snow, but no opportunity has occurred since its erection of thoroughly testing its indications.

A new 8-inch Glaisher gauge has been supplied by the Meteorological Office, and its readings observed regularly, since January, with the view of substituting it for the old square 100-inch area gauge hitherto employed for check upon the Beckley S.R. gauge, on the completion of a full year's comparison of the two gauges.

Seven months' observations have also been made of a second 8-inch gauge, with the view of determining the effect of paint upon the inner surface of the collecting funnel.

During the period that the east room of the Observatory was undergoing alteration, the working standard barometer, Newman 34, was temporarily removed to a position a few yards distant in the North Hall. Comparisons were made with the Welsh standards (which were carefully cased in, during the time of occupation of the room by workmen), both before, subsequent to its removal, and after its replacement in its old position.

The following is a summary of the number of meteorological observations made during the past year:—

Readings of standard barometer	1740
,, dry and wet thermometers	3480
,, maximum and minimum thermometers	732
,, radiation thermometers	1285
,, rain gauges	1532
Cloud and weather observations	1882
Measurements of barograph curves	8764
,, dry bulb thermograph curves	9462
,, wet bulb thermograph curves	8668
,, wind (direction and velocity)	17472
,, rainfall curves	795
,, sunshine traces	1891

In compliance with a request made by the Meteorological Council to the Committee, Mr. Whipple visited and inspected during his vacation the Observatories at Aberdeen, Glasgow, Stonyhurst, and Oxford, as well as the anemographs at Swanbister, North Shields and Fleetwood.

Mr. Baker also inspected the Falmouth and Valencia Observatories as well as the Anemographs at Mountjoy Barracks (Dublin) and Holyhead.

Advantage was taken of these visits to fit Stonyhurst lifters to

the Beckley rain gauges at Aberdeen, Falmouth, and Valencia, and one has since been forwarded to Dr. Dreyer for him to fit at Armagh.

The barograph and thermograph formerly in use at the Armagh Observatory, after being put in thorough repair, have been erected in the Verification-house and temporarily set to work, awaiting the decision of the Meteorological Council as to their final disposition.

With the sanction of the Meteorological Council, weekly abstracts of the meteorological results have been regularly forwarded to, and published by 'The Times' and 'The Torquay Directory.' Data have also been supplied to the Council of the Royal Meteorological Society, the editor of 'Symons's Monthly Meteorological Magazine,' the Secretary of the Institute of Mining Engineers, Captain Abney, Dr. Rowland, and others. The cost of these abstracts is borne by the recipients.

Since January last tables of the monthly values of the rainfall and temperature have been prepared and sent to the Meteorological Sub-Committee of the Croydon Microscopical and Natural History Club for publication in their Proceedings. Detailed information of all thunderstorms observed in the neighbourhood during the year has also been regularly forwarded to the Royal Meteorological Society soon after their occurrence, special forms having been provided by the Society for the purpose of collecting such information with the view to special investigation.

Electrograph.—The electrograph under repair at time of last Report, owing to its partial destruction by fire, has been put in thorough order. The de la Rue battery, employed to charge it, has been cleaned, and its cells refilled by the makers. The scale-value of the instrument has been again determined by means of the portable electrometer (White's) and found to be practically unaffected by the accident.

A paper giving a summary of the results afforded by the instrument is at present in preparation.

The electrometer lent to Mr. Abercromby for the purpose of making observations during his expedition to Teneriffe was returned to the Observatory in good order on the termination of his experiment, and on trial the value of the scale division was found to be unaltered.

In consequence of an accident whilst cleaning, the instrument required re-adjustment in March, but no alteration was found to have resulted to its sensitiveness when again tested at the laboratory in Charlotte Street, facilities being afforded for this by the kindness of the Chairman.

III. Solar Observations.

The sketches of Sun-spots, as seen projected on the photoheliograph screen, have been made on 150 days, in order to continue Schwabe's enumeration, the results being given in Appendix II, Table IV.

Transit Observations.—Regular observations of solar and of sidereal transits have been taken, for the purpose of keeping correct local time at the Observatory, and the clocks and chronometers have been compared daily.

The clocks, French, Shelton K. O., Shelton 35, and the chronometers Breguet No. 3140, and Arnold 86 are kept carefully rated as time-keepers at the Observatory, and the mean-time clock, Dent 2011, lent by the Astronomer-Royal, is also in use in daily comparisons with the chronometers on trial.

The chronometer, Molyneux No. 2126, is used as a "hack chronometer" in order to facilitate the inter-comparison of the clocks.

The scale, figures, &c., on the south meridian mark in connexion with the transit-instrument having become somewhat obliterated through age and exposure, steps were taken to remedy this defect, and some slight improvements introduced.

IV. Experimental Work.

Photo-nephograph.—The past year has been particularly unfavourable to cloud photography at the Observatory.

The opportunities of taking negatives of cirrus, to which particular attention is directed, were rare in the earlier months of the summer, and during the later the builders' operations prevented, in a great measure, the work being carried on.

Several modifications have been introduced into the system of observing, materially simplifying it, and the mathematical treatment of the pictures has also been temporarily set aside in favour of mechanical methods, which afford results of sufficient accuracy in a small fraction of the time occupied by the other plans of reduction which have been employed hitherto.

Observations of cloud height, drift, and direction have been treated in this manner for 1887 and for 1888, generally with satisfactory results. During April special photographs were taken with one camera only, for showing the structural change in cirrus in short intervals of time, and seven sets of negatives were procured, exhibiting the extensive alteration sometimes observed in this class of cloud in a couple of minutes.

Time Signals.—With a view of obtaining the time at the Observatory for pendulum work to a high degree of accuracy, and also for comparing daily the time as determined by the Observatory Transit with that distributed by the Postmaster-General from St. Martin's-le-

Grand, application was made to H.M. Commissioners of Woods and Forests for permission to erect a telegraph line from the Observatory to the London and South Western Railway skirting the Old Deer Park. This was granted, and a line has been set up placing the Observatory in direct electrical communication with the Chief Post Office in Richmond.

A relay and chronograph have been purchased and placed in the circuit, and every morning, excepting Sundays and holidays, the 10 A.M. signal from the Royal Observatory, Greenwich, is recorded beside the beats of the Observatory Standard Clock (French) on the same tape. The signals have been observed daily by means of the galvanometer for the past two months, but the chronograph was only regularly set to work on the 31st October, delay having arisen on account of the necessity of protecting the apparatus against lightning.

The cost of the chronograph and attachments to the Standard Clock has been defrayed by a grant from the Royal Society.

Pendulum Experiments.—The swinging of the Indian Invariable Pendulums at the Observatory has been delayed by the operations attendant on the establishment of the time signal connexion with the General Post Office, and also by failure, up to the present, of information from the American officers as to certain details of their practice when observing with the apparatus in America and elsewhere.

Meanwhile experiments have been made to determine the vacuum correction of the two thermometers, Nos. K.S. 667 and 668, used on the dummy to replace those broken in travelling. It was observed that a reduction of 27 inches in the barometric pressure lowered their zero points by 0·25°. Other observations were also made to find the relative degree of accordance during changes of temperature between the indications of the thermometers in the interior of the vacuum-chamber and that attached to the Richard thermograph placed in close proximity to its outer surface.

During these trials the holding capacity of the chamber has been thoroughly tested and found to stand low pressures extremely well.

Constants of Robinson Anemometers.—By permission of the Committee, Mr. Whipple has attended at Hersham on several occasions, and assisted Mr. W. Dines, B.A., F.R. Met. Soc., in the experiments in progress, on behalf of the Wind Force Committee of the Royal Meteorological Society, for determining the value of the Robinson constant for anemometers of various dimensions, and also for verifying the factor for converting wind velocity into pressure.

The experiments are similar to those carried out at the Crystal Palace in 1874, and described in the Report for that year.

A Preliminary Report on the experiments was read before the R. Met. Soc. meeting in May, 1888, and is printed in the 'Quarterly Journal,' vol. 14, p. 253. The results compare very favourably with

those formerly obtained as discussed by Professor Stokes ('Roy. Soc. Proc.,' vol. 32, p. 170).

V. Verification of Instruments.

The following magnetic instruments have been purchased on commission and their constants determined:—

An Inclinometer for the Tiflis Observatory.
A pair of Inclinometer Needles for the Colaba Observatory.
Ditto for the U.S. Navy Department.
Ditto for the Utrecht Observatory.

The total number of other instruments compared in the past year was as follows:—

Air-meters	6
Anemometers	2
Aneroids	164
Barometers, Marine	31
,, Standard	75
,, Station	9
Compasses	7
Hydrometers	543
Inclinometers	1
Magnets	3
Rain Gauges	3
Sextants	157
,, Shades	78
Sunshine Recorders	3
Theodolites	3
Thermometers, Arctic	136
,, Avitreous or Immisch's	1591
,, Chemical	79
,, Clinical	10442
,, Deep sea	77
,, Meteorological	1074
,, Mountain	27
,, Solar radiation	3
,, Standards	73
Unifilars	1
Total	14,588

Duplicate copies of corrections have been supplied in 52 cases.
The number of instruments rejected on account of excessive

error, or which from other causes did not record with sufficient accuracy, was as follows:—

Thermometers, clinical	51
,, ordinary meteorological	16
Various	221

7 Standard Thermometers have also been calibrated, and supplied to 2 societies and 2 individuals during the year.

There are at present in the Observatory undergoing verification, 22 Barometers, 482 Thermometers, 2 Hydrometers, and 4 Sextants.

Sextant Verification.—The number of sextants submitted for examination continues to increase, having amounted during the past year to 157.

VI. Rating of Watches.

639 entries of watches for rating were made as contrasted with 510 during the corresponding period of last year. They were sent for testing in the following classes:—

For class A, 569; class B, 51; and class C, 19.

Of these 218 failed to gain any certificate; 8 passed in C, 46 in B, 367 in A, and 28 of the latter obtained the highest possible form of certificate, the class A *especially good.*

In Appendix III will be found statements giving the results of trial of the 30 watches which obtained the highest numbers of marks during the year, the premier position being attained—with 89·0 marks—by a keyless, single-roller, going-barrel, centre-seconds watch, submitted by W. Holland, Rockferry, Birkenhead.

This total exceeds that of last year, and it is also extremely satisfactory to note that a continued increase has taken place in the proportion of watches gaining more than 80 marks, the number this year being 53.

No difficulty has been experienced in maintaining the three safes—in which the watches are placed during rating—at the three temperatures of 40°, 65°, and 90° respectively, all the year round.

Special attention continues to be given, as before, to the examination of *pocket chronographs*, in accordance with the request of the Cyclists' Union; and in consequence of numerous enquiries from manufacturers, timers, &c., a set of rules has been drawn up, as follows, which are adhered to as far as practicable in testing chronographs.

1. After the usual A or B tests are finished the watch is run with the chronograph work in continual action for one or two periods of 24 hours each, and a note made of the maximum effect produced upon the ordinary daily rate, by the chronograph mechanism being in constant action.

2. This maximum effect must not exceed ± 5 seconds.

3. In addition to the above 24-hour trials, the watch—with a view of testing its starting, stopping, and recording qualifications—is also subjected to shorter tests, varying from a few seconds to an hour or more in duration.

4. When the chronograph mechanism is in action, and pressure is applied to the knob or push-piece, the chronograph hand or hands must either stop dead at once, or else must run on unaffected until stronger force is used.

5. There must be a complete absence of "lagging," and moving only in spasmodic jumps, when pressure is applied, and perfect absence of recoil when the chronograph hand is stopped.

6. The hands must return to, and start exactly from, the zero mark, and in the case of split seconds they must run together in exact accordance.

7. The times shown by the minute-recorder must agree with the position of the fly-back hand.

8. When the chronograph action of a watch has been tested—in addition to the trial of its ordinary time-keeping qualities—an endorsement of the result will be made upon the certificate; and chronograph watches with certificates without this endorsement will be recognised as having been examined as ordinary watches only.

Marine Chronometers.—Certificates of mean daily rate and of variations of rate at each temperature have been awarded to 12 marine chronometers after undergoing the 35 days' trial as specified in the regulations.

VII. Miscellaneous.

Assistance to Observatories, &c.—Prepared photographic paper has been procured and supplied to the Observatories at Batavia, Colába, Falmouth, Lisbon, Mauritius, Oxford, St. Petersburg, Stonyhurst, and Toronto, as well as also to the Meteorological Office and the U.S. Navy Department.

Anemograph sheets have likewise been sent to Coimbra and Mauritius, blank forms for entry of observations, &c., have also been distributed to various applicants.

Hongkong Observatory.—This observatory was founded by H.M. Government in 1883, partly on the recommendation of the Kew Committee, in order amongst other objects to obtain continuous observations of terrestrial magnetism and meteorology in the eastern hemisphere between Java and Zi-Ka-Wei.

The Committee have recently been consulted by the Secretary of State for the Colonies as to the advisability of suspending the magnetic work of the Chinese Observatory for a period of three years,

but having regard to the important changes going on in the horizontal component of the earth's magnetism, on that part of the globe, they were not able to recommend the Secretary to interrupt the observations as suggested.

Marine Telescopes.—The arrangements described in last year's Report for the examination of Marine telescopes and binoculars have been completed, and a circular has been approved of by the Committee for issue to the public, stating that such instruments will in future be tested at Kew on payment of the following fees :—

Marine telescopes and superior binoculars	..	2*s.* 6*d.* each.
Opera glasses and pocket telescopes ..	..	1*s.* 6*d.* „

The Secretary of the Admiralty has communicated with the Com mittee with reference to a proposal that all such instruments purchased for use in H.M. Navy should be examined at the Observatory prior to their acceptance from the contractors' hands.

Photographic Lenses.—Captain Abney, at the suggestion of the Camera Club, as well as Mr. Galton, have proposed to the Committee the establishment of a system of testing and certifying lenses constructed for use in photographic cameras. Captain Abney has proposed a scheme of examination, and experiments are in progress with a view to carrying it out at the Observatory. It has, however, been found difficult as yet to fix upon one which would permit of a sufficiently exhaustive examination being conducted for the low fee which has been suggested, as probably the only one likely to make the certificates popular.

Ships' Lights.—The Committee have had under consideration the very important subject of the examination of ship's lights for the Mercantile Marine, by a system based upon the method now in operation at H.M. Dockyard at Chatham with reference to the lamps, lenses, and coloured shades used in H.M. Navy.

The inland isolated position of the Observatory, and the heavy and cumbersome nature of the lanterns, appear to the Committee at present to offer an almost insuperable objection to the adoption of this at Kew. There are no funds available for the alternative plan suggested of setting up a branch establishment at some locality on the banks of the Thames below London.

Exhibition.—The Committee contributed to the Annual Exhibition of the Royal Meteorological Society held in March last, a collection of apparatus for observing atmospheric electricity, principally that used at Kew by Ronalds or subsequent observers.

A list of the various objects with references is printed in the catalogue prepared by the Society.*

* See 'Quarterly Journal,' vol. 14, p. 235.

Extension of the Building.—The Chief Commissioner of Works and Public Buildings having granted permission for the Committee to undertake the erection of the additional storey to the east wing of the Observatory as mentioned in last year's Report, and having instructed Mr. Lessels, surveyor to the Board, to prepare the necessary drawings, plans, &c., tenders were invited from the principal local builders for the work. That of Messrs. J. Dorey and Co., of Brentford, for £454, was accepted, and operations were commenced on July 23rd. They have now been completed under the superintendence of Mr. Chart, H.M. Commissioners' Clerk of Works for the Hampton Court and Kew District, and Mr. Allen, his Assistant.

Library.—During the year the library has received as presents the publications of—

22 Scientific Societies and Institutions of Great Britain and Ireland, and

95 Foreign and Colonial Scientific Establishments, as well as numerous private individuals;

The reference set of 'Phil. Trans.' has been bound in cloth boards to correspond with the covers of the volumes as now issued by the Royal Society.

Old Mural Quadrant.—When in 1840 the astronomical instruments forming the equipment of George III's Observatory, were removed to Armagh, it was found impracticable to take away the 8-feet mural quadrant by Sissons, on account of its being too large to pass through the doors or windows of the room in which it was placed.

Recently, advantage was taken of the removal of the roof of the east wing of the Observatory to hoist it out and convey it to the Stores in the Office of Works at Kew, where it is now deposited. The Committee propose its ultimate consignment to the Loan Collection of Scientific Apparatus at South Kensington.

The stone wall which served for its support has been utilised as a bearer for a new gallery, providing an additional area of 29 feet long by 7 feet wide, which it is intended to devote to the Department for the Verification of Hydrometers.

Workshop.—The machine tools procured for the use of the Kew Observatory by grants from the Government Grant Fund or the Donation Fund, have been duly kept in order.

House, Grounds, and Footpath.—These have all been kept as usual during the year.

A Norton's tube-well has been driven and a pump erected in order to obtain an increased water supply, the Observatory not being in connexion with the mains of Richmond.

PERSONAL ESTABLISHMENT.

The staff employed is as follows:—

G. M. Whipple, B.Sc., Superintendent.
T. W. Baker, Chief Assistant.
H. McLaughlin, Librarian.
E. G. Constable, Observations and Rating.
W. Hugo, Verification Department.
J. Foster „ „
T. Gunter.
W. J. Boxall, and five other Assistants.

The Committee feel that they cannot permit the lamented death of Professor Balfour Stewart to pass unnoticed.

Professor Stewart's connexion with the Observatory originated in 1856, when it was under the control of the British Association. In February of that year he joined the staff as an Assistant Observer to Mr. John Welsh; his stay was, however, short, as he left soon after in October to become Assistant to Professor Forbes at Edinburgh, but returned in 1859 as the Superintendent, accepting the appointment when offered him on the death of Mr. Welsh. He relinquished the superintendence in 1871, in order to reside at Manchester as Professor of Physics in Owens College, but maintained a most lively interest in the operations of the Observatory, especially in the solar and magnetic work, being engaged in a discussion of certain of the Kew magnetic observations even up to the time of his death. The most important of his papers referring to these and similar observations are enumerated in the appendix to Mr. Scott's "History of the Kew Observatory."*

(Signed) WARREN DE LA RUE, *Chairman.*

November 27th, 1888.

* See 'Roy. Soc. Proc.,' vol. 39, pp. 37–86 (1886).

The Kew Observatory. Account of Receipts and Payments for the year ending November 3rd, 1883.

Dr. **RECEIPTS.**

	£	s.	d.
To Balance from 1886-87	£775	11	8
Royal Society (Gassiot Trust)	492	10	9
,, (Pendulum)	250	0	0
Meteorological Office (Allowance)	400	0	0
Experimental Work	67	1	8
Miscellaneous	84	15	8
Verifications	890	2	7
Rating of Watches and Chronometers	532	1	11
	3492	4	3
Meteorological Office for Postages and Porterages	5	16	3
Commissions executed for Colonial and Foreign Institutions, &c.	291	19	9
	£3790	0	3

PAYMENTS. *Cr.*

	£	s.	d.
By Salaries and Extra	£1596	15	7
Gas, Fuel, Rent, Insurance, &c.	136	8	3
Stationery, Postages, Porterages, &c.	70	17	0
Instruments, Apparatus, &c.	45	4	8
Experimental work	32	6	5
Miscellaneous	43	13	10
Exhibition	2	13	9
Verifications	130	1	10
Rating of Watches and Chronometers	106	6	1
Pendulum	79	17	3
	2244	4	8
Extension of the Building	405	0	0
Postages and Porterages, &c., for Meteorological Office	32	3	2
Commissions executed for Colonial and Foreign Institutions, &c.	270	5	7
Balance—Bank of England	747	6	2
London and County Bank	71	10	10
Cash in hand	19	9	10
	838	6	10
	£3790	0	3

November 22, 1883. Examined and compared with the Vouchers, and found correct. (Signed) W. G. ADAMS, *Auditor.*

ASSETS.

	£	s.	d.
By Balance as per Statement	838	6	10
Meteorological Office Allowance, Experimental, and Sundries	106	13	7
Verification Fees due, &c.	68	0	5
Rating of Watches, &c.	64	1	4
Photographic Paper	6	0	9
Commissions, &c.	19	8	8
Blank Forms	23	5	3
Standard Thermometers in Stock	80	14	0
	£1206	10	10

LIABILITIES.

	£	s.	d.
To Gas, Fuel, and House Account	24	3	7
Building Extension and Painting	100	0	0
Pendulum Account—Unspent Balance	210	12	10
,, ,, Outstanding Account	3	0	0
Chemicals, &c.	19	5	5
Purchases on Commission	34	19	0
Balance	814	10	0
	£1206	10	10

November 23, 1883.

(Signed) G. M. WHIPPLE,
Superintendent.

APPENDIX I.

Magnetic Observations made at the Kew Observatory, Lat. 51° 28′ 6″ *N. Long.* 0^{h} 1^{m} 15^{s}·1 *W., for the year October* 1887 *to September* 1888.

The observations of Deflection and Vibration given in the annexed Tables were all made with the Collimator Magnet marked K C 1, and the Kew 9-inch Unifilar Magnetometer by Jones.

The Declination observations have also been made with the same Magnetometer, Collimator Magnet N E being employed for the purpose.

The Dip observations were made with Dip-circle Barrow No. 33, the needles 1 and 2 only being used; these are $3\frac{1}{2}$ inches in length.

The results of the observations of Deflection and Vibration give the values of the Horizontal Force, which, being combined with the Dip observations, furnish the Vertical and Total Forces.

These are expressed in both English and metrical scales—the unit in the first being one foot, one second of mean solar time, and one grain; and in the other one millimetre, one second of time, and one milligramme, the factor for reducing the English to metric values being 0·46108.

By request, the corresponding values in C.G.S. measure are also given.

The value of log π^2K employed in the reduction is 1·64365 at temperature 60° F.

The induction-coefficient μ is 0·000194.

The correction of the magnetic power for temperature t_0 to an adopted standard temperature of 35° F. is

$$0{\cdot}0001194(t_0-35)+0{\cdot}000{,}000{,}213(t_0-35)^2.$$

The true distances between the centres of the deflecting and deflected magnets, when the former is placed at the divisions of the deflection-bar marked 1·0 foot and 1·3 feet, are 1·000075 feet and 1·300097 feet respectively.

The times of vibration given in the Table are each derived from the mean of 14 observations of the time occupied by the magnet in making 100 vibrations, corrections being applied for the torsion-force of the suspension-thread subsequently.

No corrections have been made for rate of chronometer or arc of vibration, these being always very small.

The value of the constant P, employed in the formula of reduction $\frac{m}{X}=\frac{m'}{X'}\left(1-\frac{P}{r_0^2}\right)$, is −0·00168.

In each observation of absolute Declination the instrumental readings have been referred to marks made upon the stone obelisk erected 1,250 feet north of the Observatory as a meridian mark, the orientation of which, with respect to the Magnetometer, has been carefully determined.

The observations have been made and reduced by Mr. T. W. Baker.

Table I.

Observations of Inclination or Dip.

Month.	Mean Inclination.	Month.	Mean Inclination.
1887.		1888.	
October 25.....	67° 37′·9	April 23.....	67° 35′·5
26.....	67 39·1	24.....	67 35·3
		25.....	67 36·0
Mean.....	67 38·5	Mean.....	67 35·6
November 28.....	67 35·8		
29.....	67 38·2	May 22.....	67 37·0
		23.....	67 36·2
Mean.....	67 37·0	24.....	67 37·1
		Mean.....	67 36·8
December 28.....	67 39·3		
29.....	67 36·7	June 26.....	67 33·1
		28.....	67 34·9
Mean.....	67 38·0	Mean.....	67 34·0
1888.			
January 25.....	67 37·3	July 24.....	67 35·7
27.....	67 36·3	25.....	67 34·2
28.....	67 36·5	26.....	67 35·2
Mean.....	67 36·7	Mean.....	67 35·0
February 23.....	67 37·2		
24.....	67 37·1	August 27.....	67 35·8
		29.....	67 35·6
Mean.....	67 37·1	Mean.....	67 35·7
March 23.....	67 36·6		
27.....	67 36·6	September 24.....	67 35·4
		26.....	67 35·7
Mean.....	67 36·6	Mean.....	67 35·6

Table II.

Observations for the Absolute Measurement of Horizontal Force.

Month.	Log $\frac{m}{X}$ mean.	Log mX mean.	Value of m*.
1887.			
October 27th	9·12043	0·30726	0·51743
November 30th	9·12030	0·30776	0·51764
December 30th.....	9·12012	0·30796	0·51765
1888.			
January 30th.....	9·11995	0·30803	0·51760
February 28th...	9·12015	0·30813	0·51777
March 29th	9·11981	0·30826	0·51764
April 26th	9·11989	0·30817	0·51764
May 25th and 26th.....	9·11960	0·30832	0·51756
June 30th.....	9·11976	0·30859	0·51782
July 30th	9·12008	0·30840	0·51789
August 28th.....	9·11986	0·30823	0·51767
September 26th.....	9·12022	0·30793	0·51770

Table III.—Solar Diurnal Range of the Kew Declination as derived from selected quiescent days.

Hour.	Summer mean.	Winter mean.	Annual mean.
1888.			
Midnight	−0′·7	−0′·7	−0′·7
1	−0·6	−0·6	−0·6
2	−0·8	−0·3	−0·5
3	−1·1	−0·5	−0·8
4	−2·0	−0·2	−1·1
5	−2·6	−0·1	−1·4
6	−3·4	−0·3	−1·8
7	−3·9	−0·7	−2·3
8	−4·0	−1·3	−2·6
9	−3·5	−1·3	−2·4
10	−1·0	−0·8	−0·9
11	+1·8	−0·2	+0·8
Noon	+4·2	+1·3	+2·8
13	+5·9	+2·8	+4·4
14	+5·4	+2·0	+3·7
15	+4·3	+1·2	+2·8
16	+2·7	+0·6	+1·7
17	+1·2	+0·3	+0·8
18	+0·1	−0·2	0·0
19	−0·1	−0·7	−0·4
20	−0·3	−0·7	−0·5
21	−0·4	−0·8	−0·6
22	−0·6	−1·0	−0·8
23	−1·1	−1·0	−1·0

* m = magnetic moment of vibrating magnet.

Table IV.

Month.	Declination.	Magnetic Intensity.								
		English Units.			Metric Units.			C. G. S. Measure.		
	Mean of Observations.	X, or Horizontal Force.	Y, or Vertical Force.	Total Force.	X, or Horizontal Force.	Y, or Vertical Force.	Total Force.	X, or Horizontal Force.	Y, or Vertical Force.	Total Force.
	West.									
1887.	° ′ ″									
October	18 13 52	3·9211	9·5330	10·3079	1·8117	4·3955	4·7528	0·1812	0·4396	0·4753
November	18 12 58	3·9240	9·5282	10·3046	1·8093	4·3933	4·7513	0·1809	0·4393	0·4751
December	18 9 26	3·9257	9·5404	10·3164	1·8101	4·3989	4·7567	0·1810	0·4399	0·4757
1888.										
January	18 12 18	3·9268	9·5326	10·3098	1·8106	4·3953	4·7537	0·1811	0·4395	0·4754
February.....	18 7 36	3·9264	9·5348	10·3115	1·8104	4·3963	4·7544	0·1810	0·4396	0·4754
March.....	18 7 51	3·9284	9·5359	10·3134	1·8113	4·3968	4·7553	0·1811	0·4397	0·4755
April	18 8 1	3·9277	9·5262	10·3041	1·8110	4·3924	4·7511	0·1811	0·4392	0·4751
May.....	18 7 16	3·9297	9·5405	10·3181	1·8119	4·3990	4·7575	0·1812	0·4399	0·4758
June	18 8 27	3·9302	9·5198	10·2991	1·8122	4·3894	4·7488	0·1812	0·4389	0·4749
July.....	18 8 27	3·9279	9·5218	10·3003	1·8111	4·3904	4·7493	0·1811	0·4390	0·4749
August	18 7 4	3·9281	9·5280	10·3058	1·8112	4·3932	4·7518	0·1811	0·4393	0·4752
September	18 5 4	3·9252	9·5201	10·2975	1·8098	4·3896	4·7480	0·1810	0·4390	0·4748

APPENDIX II.

Meteorological Observations.—Table I.

Mean Monthly results.

Months.	Thermometer.								Barometer.*					Mean vapour-tension.
	Mean.	Means of—			Absolute Extremes.				Mean.	Absolute Extremes.				
		Max.	Min.	Max. and Min.	Max.	Date.	Min.	Date.		Max.	Date.	Min.	Date.	
1887.	°	°	°	°	°	d. h.	°	d. h.	ins.	ins.	d. h.	ins.	d. h.	in.
Oct.....	44·8	51·8	38·6	45·2	60·3	8 2 P.M.	26·4	26 {7 & 8 A.M.}	30·104	30·623	18 9 A.M.	28·844	30 5 A.M.	·235
Nov.	41·0	45·1	36·4	40·8	53·8	4 1 „	23·2	16 7 „	29·716	30·419	16 10 „	28·796	4 3 „	·221
Dec.	38·2	42·2	34·0	38·1	54·6	9 1 A.M.	25·5	27 7 „	29·869	30·504	2 10 „	29·275	15 {4 & 5 A.M.}	·197
1888.														
Jan.....	38·1	41·8	34·0	37·9	51·1	8 6 P.M.	24·2	30 8 „	30·250	30·743	10 11 „	29·245	31 5 P.M.	·198
Feb.	35·6	39·3	32·0	35·7	51·3	6 2 „	21·6	2 8 „	29·972	30·431	28 9 P.M.	29·438	1 1 A.M.	·170
March..	38·5	44·0	33·9	39·0	55·3	10 3 „	25·3	2 5 „	29·627	30·337	1 1 „	28·732	28 3 P.M.	·188
April...	43·6	50·7	37·4	44·1	64·5	15 2 „	28·3	6 3 „	29·902	30·289	6 Midt.	29·469	30 Midt.	·219
May ...	52·3	61·1	43·7	52·4	73·8	19 3 „	34·3	12 5 „	30·065	30·499	11 8 A.M.	29·411	1 9 A.M.	·278
June...	57·5	65·5	50·5	58·0	82·0	25 3 „	44·4	17 Midt.	29·938	30·266	1 10 P.M.	29·538	29 4 P.M.	·365
July ...	57·9	64·6	52·0	58·3	71·3	22 3 „	43·6	11 8 A.M.	29·779	30·144	13 {6, 7, & 9 A.M.}	29·394	28 {4 & 5 A.M.}	·394
Aug....	58·5	66·2	51·1	58·7	79·7	10 1 „	43·4	19 5 „	30·018	30·343	31 Midt.	29·500	28 9 P.M.	·392
Sept....	55·4	62·8	48·7	55·8	71·0	15 4 „	39·2	30 11 P.M.	30·156	30·518	12 10 P.M.	29·562	29 11 „	·368
Means..	46·8	52·9	41·0	47·0	..	....	..	....	29·950	..	....	..	....	·269

The above Table is extracted from the "Hourly Readings," vols. 1887-88, of the Meteorological Office, by permission of the Meteorological Council.

* Reduced to 32° at M.S.L.

Meteorological Observations.—Table II.

Kew Observatory.

Months.	Mean amount of cloud (0=clear, 10=overcast).	Rainfall*.			Weather. Number of days on which were registered								Wind†. Number of days on which it was							
		Total.	Maximum.	Date.	Rain.	Snow.	Hail.	Thunderstorms.	Clear sky.	Overcast sky.	Gales.	Calms.	N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W.	Variable.
1887.		in.	in.																		
October ..	7	1·465	0·650	29	12	1	2	..	4	14	..	9	10	2	..	..	2	5	4	7	1
November	7	3·050	0·510	3	20	1	1	..	4	14	1	3	4	8	6	..	3	5	4	..	..
December	7	1·360	0·265	14	15	3	1	..	3	16	..	2	7	5	..	1	3	4	9	2	..
1888.																					
January ..	7	0·865	0·270	20	12	2	1	..	3	17	1	5	2	3	3	1	3	7	7	4	1
February .	8	0·905	0·500	13	12	7	..	..	..	23	..	..	6	11	..	..	..	3	5	3	1
March ...	8	3·050	0·420	26	19	4	1	1	..	21	3	..	6	5	1	1	2	7	3	6	..
April	7	2·215	0·680	19	15	2	2	2	1	15	..	..	5	7	3	..	1	8	4	1	1
May.....	5	1·130	0·380	16	4	..	..	..	8	8	1	2	2	7	3	3	2	6	6	1	1
June	7	2·350	0·515	26	20	..	..	4	1	16	..	2	9	3	2	..	4	6	4	..	2
July.....	8	4·610	0·500	5	25	..	..	6	1	22	..	3	2	2	2	1	5	11	3	5	..
August ..	6	2·810	0·880	1	12	..	1	2	4	12	..	1	4	2	..	1	5	13	2	3	1
Septembe-	6	1·435	0·250	29	13	..	..	..	8	10	..	5	6	7	5	..	1	6	3	2	..
Totals..		25·245			179	20	9	15	37	188	6	32	63	62	25	8	31	81	54	34	8

* Measured at 10 A.M. daily by gauge 1·75 feet above surface of ground. † As registered by the anemograph.

Meteorological Observations.—Table III.

Kew Observatory.

Months.	Bright Sunshine.				Maximum temperature in sun's rays. (Black bulb *in vacuo*.)			Minimum temperature on the ground.			Horizontal movement of the Air.*		
	Total number of hours recorded.	Mean percentage of possible sunshine.	Greatest daily record.	Date.	Mean.	Highest.	Date.	Mean.	Lowest.	Date.	Average hourly Velocity.	Greatest hourly Velocity.	Date.
1887.	h. m.		h. m.		deg.	deg.		deg.	deg.		miles.	miles.	
October	108 6	33	9 6	12	94	113	8	30	15·7	13	8	34	30
November	44 6	16	5 54	30	64†	99	3	32	17·6	16	10	42	1
December	42 36	17	5 18	5	63	82	2	27	18·7	27	9	31	13
1888.													
January	41 0	16	5 12	30	60	85	23	29	15·7	1	11	40	26
February	32 6	11	4 36	1	69	88	13	28	14·1	2	15	34	21
March	58 54	16	9 6	21	86	110	10	30	15·5	2	14	41	11
April	106 24	25	11 30	30	98	123	29	32	18·7	7	12	30	25
May	225 6	46	14 48	23	119	133	31	37	28·1	11	12	39	2
June	132 18	27	13 54	13	113	141	1	46	33·5	18	9	30	12
July	103 30	21	10 48	24	120	134	30	48	36·5	13	10	31	24
August	158 42	35	13 12	14	122	139	9	47	37·3	19	10	27	28
September	126 0	33	10 6	11	110	127	1	44	34·3	11	8	24	9

* As indicated by a Robinson's anemograph, 70 feet above the general surface of the ground.
† Instrument dismounted for two days.

Table IV.

Summary of Sun-spot Observations made at the Kew Observatory.

Months.	Days of observation.	Number of new groups enumerated.	Days without spots.
1887.			
October	17	2	10
November	14	2	10
December	12	4	4
1888.			
January	9	4	3
February	6	2	3
March	10	2	4
April	9	5	2
May	19	1	14
June	11	2	3
July	8	1	6
August	16	4	7
September	19	3	6
Totals	150	32	72

APPENDIX III.—Table I.

RESULTS OF WATCH TRIALS. Performance of the 31 Watches which obtained the highest number of marks during the year.

Watch deposited by	Number of watch.	Balance spring, escapement, &c.	Mean daily rate. — +Gaining. −Losing.	Mean variation of daily rate. ±	Mean change of rate for 1° F.	Difference of mean daily rate				Difference between extreme gaining and losing rates.	Marks awarded for			Total Marks. 0—100.
						Between pendant up and dial up.	Between pendant up and pendant right.	Between pendant up and pendant left.	Between dial up and dial down.		Daily variation of rate.	Change of rate with change of position.	Temperature compensation.	
			secs.	secs.	secs.	secs.	secs.	secs.	secs.	secs.				
W. Holland, Rock Ferry	3624†	Single overcoil, *s.r., *g.b.	+0·6	0·35	0·02	−1·2	+1·0	+0·5	+0·2	4·0	33·0	37·0	19·0	89·0
H. Golay, London	147106†	Double overcoil, s.r., g.b.	+3·0	0·5	0·003	−0·3	−2·1	−2·6	−1·0	5·25	29·4	36·6	19·8	85·8
Usher & Cole, London	24329†	Single overcoil, s.r., g.b.	+1·5	0·5	0·04	−0·5	−1·6	−2·1	−0·8	4·75	30·7	37·2	17·6	85·5
E. F. Ashley, London	03614†	Single overcoil, s.r., fusee	+0·7	0·4	0·06	+1·0	−1·8	−0·7	−0·8	4·5	32·0	36·8	15·8	84·6
D. Buckney, London	2930′	Double overcoil, *d r., g.b.	+3·3	0·5	0·05	+0·9	+2·0	+0·4	−2·0	5·75	30·8	36·8	16·9	84·5
Baume & Co., London	2706	Single overcoil, d.r., g.b.	+0·2	0·5	0·04	−1·3	−1·2	−3·0	+0·3	6·25	29·6	37·3	17·5	84·4
Jos. White, Coventry	31610	Single overcoil, s.r., g.b.	+0·5	0·6	0·02	−0·6	+0·5	−0·6	+0·5	4·5	27·5	38·6	18·3	84·4
Usher & Cole, London	24042†	Single overcoil, s.r., g.b.	+1·0	0·5	0·04	−0·5	−2·3	−2·6	−0·8	5·25	30·4	36·4	17·3	84·1
Stauffer & Co., London	123175	Single overcoil, d.r., g.b., bar-lever	−5·6	0·4	0·05	+2·6	−0·7	−1·5	−2·1	8·0	31·3	35·7	16·8	83·8
Stauffer & Co., London	123162	Single overcoil, d.r., g.b., bar-lever	+5·1	0·5	0·02	−2·8	−4·0	−1·5	+1·5	5·5	29·9	35·3	18·5	83·7
Jos. White, Coventry	31524†	Single overcoil, s.r., g.b.	+1·8	0·5	0·01	+0·7	+1·8	+4·9	+2·8	7·75	30·9	33·6	19·1	83·6
W. Gabriel, London	325/1000	Double overcoil, s.r., g.b.	+1·4	0·5	0·07	−1·0	−0·2	−0·1	+0·4	6·5	29·5	38·7	15·3	83·5
A. E. Fridlander, Coventry	52541†	Double overcoil, d.r., fusee	+0·6	0·4	0·04	+0·1	−2·6	−2·3	−2·6	5·0	31·1	35·1	17·1	83·3
Stauffer & Co., London	123179†	Single overcoil, d.r., g.b., bar-lever	−1·1	0·4	0·06	−0·5	−2·5	−3·0	−0·9	6·5	31·2	35·9	16·0	83·1
W. Gabriel, London	362/1000	Double overcoil, d.r., fusee	−0·6	0·5	0·05	+0·8	+2·1	+1·9	+2·4	6·75	30·2	36·2	16·7	83·1
A. E. Fridlander, Coventry	52484†	Double overcoil, d.r, g.b	+3·9	0·4	0·07	+2·3	−0·6	−0·9	−2·8	5·0	31·4	36·3	15·2	82·9
H. Golay, London	147108	Double overcoil, d.r. g.b.	+3·2	0·5	0·02	−3·8	+2·6	−0·1	+2·4	9·0	30·8	33·5	18·5	82·8
W. Holland, Rock Ferry	3614†	Single overcoil, d.r., g.b.	+1·3	0·5	0·04	+1·6	−0·6	−3·3	−1·0	6·0	30·6	34·8	17·3	82·7
Baume & Co., London	2639	Single overcoil, d.r., g.b.	+1·7	0·4	0·03	−0·7	−6·1	−2·3	−3·2	7·75	32·7	32·2	17·8	82·7
W. Holland, Rock Ferry	3578†	Single overcoil, d.r., fusee	+1·6	0·5	0·03	−2·4	+1·5	+2·9	+1·9	7·5	30·5	33·9	18·0	82·4
Usher & Cole, London	25768	Single overcoil, s.r., g.b.	+2·4	0·5	0·03	−2·9	+0·4	+1·1	+1·3	8·25	29·4	34·7	18·0	82·1

* d.r., double-roller; s.r. single-roller; g.b., going barrel. † Especially good.

Table I—*continued.*

Watch deposited by	Number of watch.	Balance spring, escapement, &c.	Mean daily rate. — +Gaining. −Losing.	Mean variation of daily rate. ±	Mean change of rate for 1° F.	Difference of mean daily rate				Difference between extreme gaining and losing rates.	Marks awarded for			Total Marks. 0—100.
						Between pendant up and dial up.	Between pendant up and pendant right.	Between pendant up and pendant left.	Between dial up and dial down.		Daily variation of rate.	Change of rate with change of position.	Temperature compensation	
			secs.	secs.	secs.	secs.	secs.	secs.	secs.	secs.				
Baume & Co., London	3000†	Single overcoil, d.r., g.b., bar-lever	+2·5	0·5	0·03	−1·4	−1·7	+3·2	+1·5	8·75	29·4	34·8	17·8	82·0
H. Golay, London	14782	Double overcoil, d.r., g.b.	+0·1	0·5	0·07	−2·6	−2·9	−1·9	+0·2	7·25	30·1	36·8	15·1	82·0
A. E. Fridlander, Coventry	52568†	Double overcoil, d.r., g.b.	+1·4	0·5	0·05	+1·6	−0·8	+2·3	−1·6	4·75	29·7	35·7	16·5	81·9
Stauffer & Co., London	122290	Single overcoil, d.r., g.b.	+1·9	0·5	0·05	+1·0	−1·2	−3·4	+0·1	7·25	30·3	34·2	16·8	81·8
Baume & Co., London	3002†	Single overcoil, d.r., g.b., bar-lever	+1·7	0·4	0·07	−1·0	−4·6	−4·2	−2·6	6·0	32·9	33·2	15·6	81·7
H. Golay, London	14780	Double overcoil, d.r., g.b.	+1·4	0·6	0·002	−0·7	+0·9	−0·2	+5·3	9·0	27·7	34·1	19·9	81·7
Baume & Co., London	2702	Single overcoil, d.r., g.b.	+1·3	0·7	0·03	+1·7	−0·7	−0·0	−0·9	5·75	26·5	37·1	18·0	81·6
G. Barter, London	14727	Double overcoil, d.r., g.b.	+2·3	0·5	0·06	−0·7	−2·4	−0·9	+2·2	7·0	29·7	36·0	15·8	81·5
D. Keys, London	15889	Single overcoil, d.r., g.b.	+0·2	0·6	0·04	+1·0	+2·2	−0·6	+2·4	6·0	28·8	35·0	17·6	81·4
Usher & Cole, London	25811†	Single overcoil, s.r., g.b.	−0·2	0·4	0·05	+0·7	+4·1	−2·9	+0·2	8·5	31·3	33·6	16·4	81·3

† Especially good.

Table II.

Highest Records obtained by Complicated Watches during the year.

Description of watch.	Number.	Deposited by	Marks awarded for			Total marks, 0—100.
			Variation.	Position.	Temperature.	
Minute and seconds chronograph and repeater ..	52568	A. E. Fridlander, Coventry ...	29·7	35·7	16·5	81·9*
,, ,, ,, ,, ..	14799	H. Golay, London	26·0	30·2	18·5	74·7
,, ,, ,, ,, ..	14793	H. Golay, ,, ...	23·5	34·2	16·4	74·1
Split-seconds and minute-recorder chronograph .	2773	Baume and Co., London.....	27·0	33·2	15·7	75·9
,, ,, ,, ,, .	1070	H. Golay, ,, ...	24·0	31·3	16·9	72·2
,, ,, ,, ,, .	2500	Baume and Co. ,, ...	27·8	31·8	12·5	72·1
Minute and seconds chronograph.....	52484	A. E. Fridlander, Coventry ...	31·4	36·3	15·2	82·9*
,, ,, ,, ...	14780	H. Golay, London	27·7	34·1	19·9	81·7
,, ,, ,, ...	79352	The English Watch Company, Birmingham	25·1	35·0	18·5	78·6
Perpetual calendar and repeater.....	14782	H. Golay, London	30·1	36·8	15·1	82·0
,, ,, ,, ...	14794	H. Golay, ,, ...	23·9	31·6	19·5	75·0
,, ,, ,, ...	14792	H. Golay, ,, ...	28·6	32·9	11·2	72·7
Repeater	14727	G. Barter, London.....	29·7	36·0	15·8	81·5
,, ...	14785	H. Golay, ,, ...	30·3	35·9	14·0	80·2*
,, ...	14784	H. Golay, ,, ...	31·3	34·2	13 3	78·8*
Ordinary seconds chronograph	47147	Carley and Co., London.....	28·1	35·5	17·6	81·2
,, ,, ,, ...	03603	E. F. Ashley, London.....	29·5	34·6	14·7	78·8
,, ,, ,, ...	80543	Rotherham and Sons, Coventry	24·9	29·2	18·3	72·4

* Especially good.

APPENDIX IV.

List of Instruments, Apparatus, &c., the Property of the Kew Committee, at the present date out of the custody of the Superintendent, on Loan.

To whom lent.	Articles.	Date of loan.
G. J. Symons, F.R.S.	Portable Transit Instrument	1869
The Science and Art Department, South Kensington.	The articles specified in the list in the Annual Report for 1876, with the exception of the Photo-Heliograph, Pendulum Apparatus, Dip-Circle, Unifilar, and Hodgkinson's Actinometer.	1876
Lieutenant A. Gordon, R.N.	Unifilar Magnetometer by Jones, No. 102, complete, with three Magnets and Deflection Bar. Dip-Circle, by Barrow, one Pair of Needles, and Magnetizing Bars. One Bifilar Magnetometer. One Declinometer. Two Tripod Stands.	1883
General Sir H. Lefroy, R.A., F.R.S.	Toronto Daily Registers for 1850–3	1885
Professor W. Grylls Adams, F.R.S.	Unifilar Magnetometer, by Jones, No. 101, complete. Pair 9-inch Dip-Needles with Bar Magnets ...	1883 1887
Professor O. J. Lodge	Unifilar Magnetometer, by Jones, No. 106, complete. Barrow Dip-Circle, No. 23, with two Needles, and Magnetizing Bars. Tripod Stand.	1883
Mr. W. F. Harrison .	Condensing lens and copper lamp chimney ..	1883
Captain W. de W. Abney, F.R.S.	Mason's Hygrometer, by Jones	1885
Professor Rücker ...	Tripod Stand	1886
Lord Rayleigh	Standard Barometer (Adie, No. 655)	1885
Mr. J. E. Cullum ..	Alt-Azimuth by Robinson, C. 42	1888